When Rain Hits the Land

INTRODUCTION:
Think about what happens when rain hits the land. What happens to the water as it falls to the ground? Imagine a rainstorm in a wooded area. Grass, leaves, soil, and vegetation act like a sponge, soaking up the water into the floor of the forest. Now imagine the same rainstorm on a road, or in a parking lot. These surfaces are solid, and water has nowhere to go. As it flows along, it gains speed and is able to pick up and carry nutrients or chemicals that might be on the land. Soil not protected by vegetation is easily eroded or washed away by fast moving water. In this activity you will work in small groups to test materials that represent various land surfaces and record your observations.

MATERIALS:
Your group will need:

Part I :
- protractor
- ruler
- cardboard milk carton
- plastic cup with small holes in the bottom
- dirt
- sod
- grass
- gravel
- sand
- water
- pitcher or empty jug for pouring water
- pan or bucket for catching water
- stop watch

Part II :
- metal can (or other cylinder) with two open ends
- pitcher or empty jug for pouring water
- stop watch

Part III :
- large sheet of paper or posterboard
- markers, pens, crayons
- other art supplies, as needed

Charles R. Hazard

PROCEDURE:

Part I:

In this part, you will conduct an experiment to find out how different land surfaces affect the rate and amount of water that will run off when it hits that surface.

1. Read the introduction to this activity. Explain how a stream might be affected by a rain-storm in a paved area? How is this different from what you expect would happen in the forest described above?

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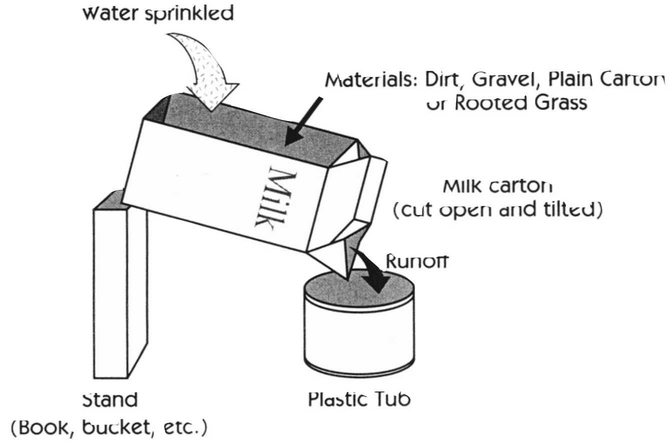
2. Your group is going to set up an experiment testing different land surfaces. Take a look at the diagram of the experiment below. You will be filling the carton with a material, creating a rain-storm using your plastic cup, and timing and measuring the resulting runoff. Make a list of all the things that must be done exactly the same way during each trial in order to get good results. These represent the <u>experimental</u> <u>controls.</u> Share your list with another group.



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3. All groups will run their first trial using only the plain surface of the milk carton. What land surface do you think the bare carton represents?

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4. Choose three materials from the following list that you and your group members would like to test. List the materials that you choose in the Runoff Data Table on page 61.

- dirt
- sod
- grass
- gravel
- sand

5. Because runoff will vary depending on how steep a hill is, each group in your class will run their experiment with their carton at a different angle. Choose which angle you will use throughout your experiment based on the range of choices given by your teacher and write your angle here:

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6. You should make sure that you are not using the same angle as any other group in the class. Predict how your angle will affect the results of your experiment.

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7. Before running your experiment, predict which of your testing materials will produce the fastest and the most runoff. Rank the materials from 1 (fastest/most runoff) to 4 (slowest/least runoff), and give a brief explanation for your answer.

1 ______________________________

2 ______________________________

3 ______________________________

4 ______________________________

8. Each person in your group will be responsible for a certain job in the experiment. Use the descriptions below to decide who will be in charge of each job.

JOB DESCRIPTIONS

Title	Duties
Water Manager	Measures water quantities Sprinkles water for each trial Disposes of wastewater as instructed
Timekeeper/ Recorder	Times each trial Records all data in the chart Keeps group on time
Materials Manager	Organizes all materials Places materials in milk carton each time Cleans the carton after each trial Returns all materials after use
Quality Control	Makes sure the procedures are followed correctly Makes sure everyone has a chance to speak Makes sure everyone understands
Cleanup Crew	Washes materials, desktops, and floor area

9. Use information from the previous steps and questions to write a plan for conducting your experiment. Write your plan on a separate piece of paper and check it with your teacher when you are finished.

10. Conduct your experiment following your group's plan. Record all data in the Runoff Data Table on the following page.

Runoff Data Table

Material	Predicted Speed	Predicted Amount of Runoff	Amount of Water Added	Amount of Runoff Collected	Time for Runoff to Slow to One Drop every 3 Seconds	Observations
Final Combination						

11. Once you have finished running your experiment, use the results from each trial to mix materials in an attempt to make the slowest and least possible runoff. You must follow two new rules:
    - You must tilt your carton at a 20 degree angle.
    - You may only fill your carton a total of 3 cm full with materials. List the materials you use in the Runoff Data Table under "Final Combination". Record your results.

12. When your group has finished, compare your results with those of another group. Which combination produced the best results for slowing and reducing runoff?

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13. Now look back at the predictions that you made for each material. How correct were your predictions? In what way did your predictions differ from actual results?

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14. How would you explain these differences?

15. Individually, use graph paper to create a graph that shows how different materials affect the speed and amount of runoff. Be sure to label all parts of your graph.

16. Below, give examples of land surfaces in your schoolyard that correspond to materials you tested.

17. Based on what you learned about land surfaces during this activity, describe the runoff that you think would occur around your school after a big rainstorm.

Part II:

In this part of the activity, your group will have the chance to test surfaces around your school that you listed in question 16. Answer questions 1, 2, and 3 before you go outside, so that you will be sure to understand this experiment.

1. In this section, you will be pouring water into a can that is placed on each surface and recording the amount of time that it takes for the water to soak into the ground. List the things that you think should be kept constant in this experiment.

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2. Before you go outside, decide who will be responsible for each task. You will need a timer, a recorder, someone to screw the percolation can into the ground, someone to pour the water, and at least one person to observe the water as it seeps into the ground or runs along the surface. Decide the following things before you go outside:

   - how much water will you pour at each location? ____________
   - at what point will you begin and stop timing? ____________

3. In order for you to make sense of the data you collect, you will need to record your results in a data chart. On a separate piece of paper, create a data chart that you can use to record the land surfaces you test and the time that each one takes to absorb the water.

4. Now go outside and test four surfaces around your school. Be sure to record your results in your data chart!

5. Summarize and explain the results of your "perc" test. Which surfaces soaked up water quickly? Which did not absorb water?

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Part III:

In this section, you will illustrate the land uses around you by making a map that shows where different types of land surfaces are located around your school.

1. Decide within your group how you will show different land uses on your map. In the space below, draw a key for your map that indicates the different land surfaces that you will be marking. The key will make your map easy to understand!

2. Use a large sheet of paper to draw your schoolyard.

3. Add your key to the schoolyard map when you are finished.

4. List the different land uses that you found in your schoolyard in the table below. Beside each one, decide whether water would more likely "run off" or "soak in" when it hits the surface.

Land Use	**Runoff or Soak In?**

In general, how do you think your schoolyard rates as far as land uses? For example, are there more parking lots than fields? What things might you change to reduce runoff?

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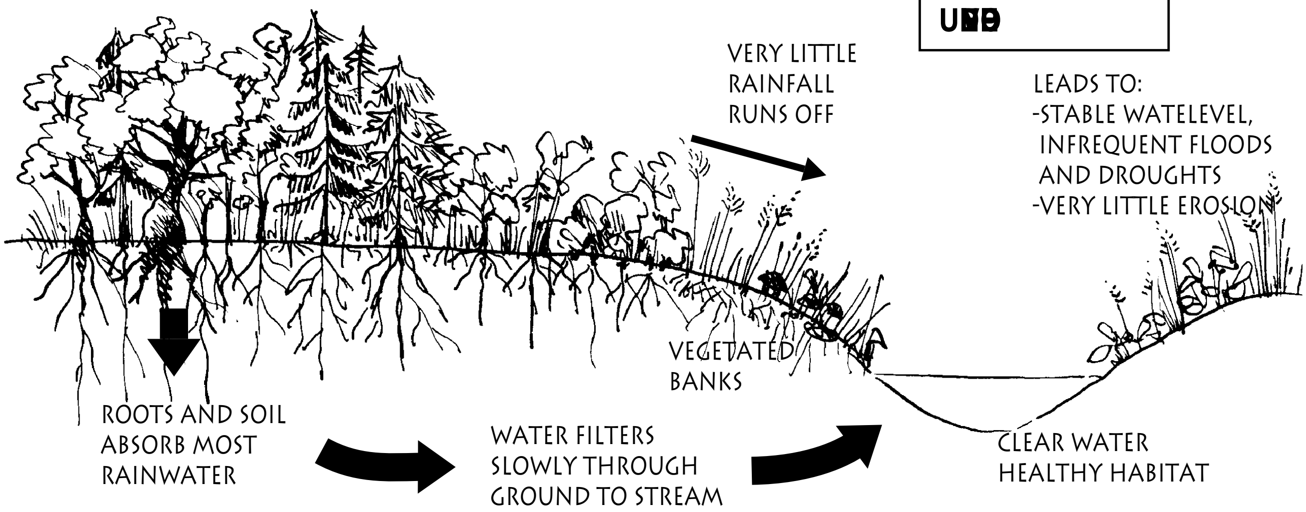
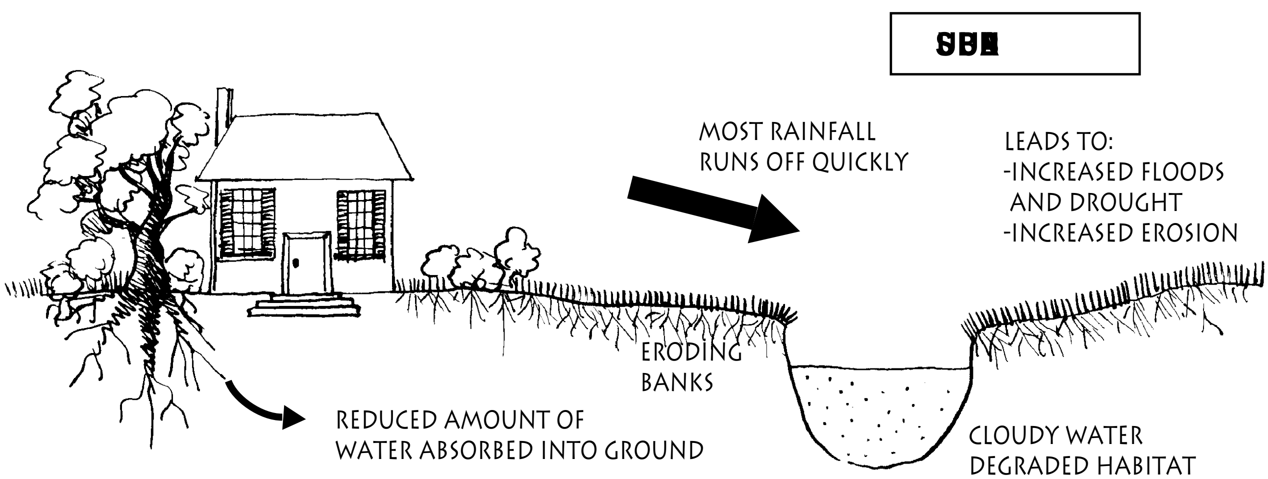
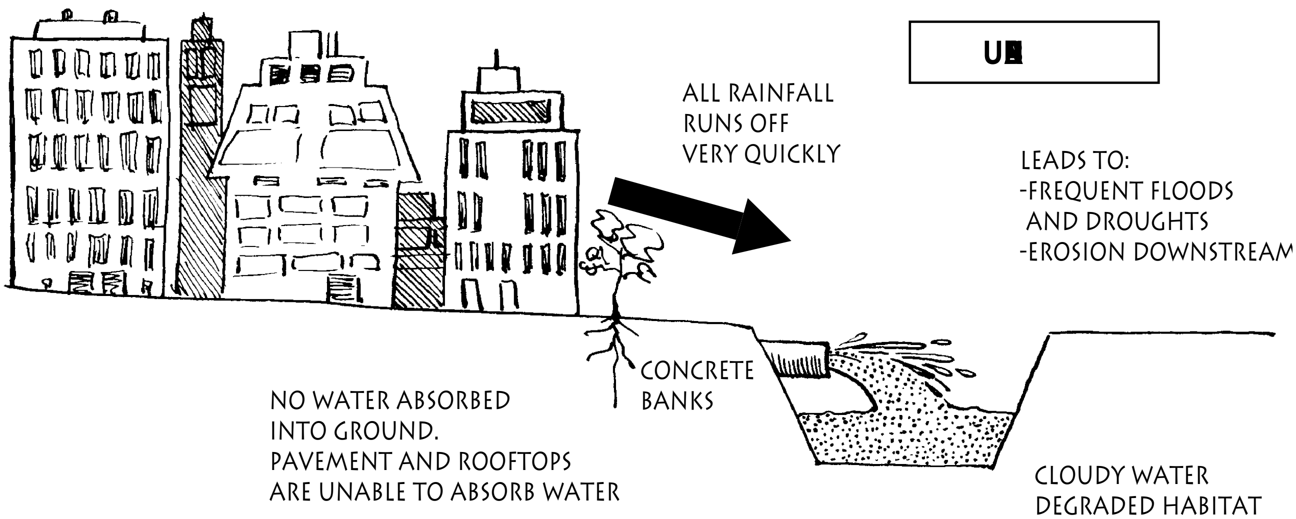
RUNOFF



VERY LITTLE
RAINFALL
RUNS OFF
LEADS TO:
-STABLE WATELEVEL,
INFREQUENT FLOODS
AND DROUGHTS
-VERY LITTLE EROSION
VEGETATED
BANKS
ROOTS AND SOIL
ABSORB MOST
RAINWATER
WATER FILTERS
SLOWLY THROUGH
GROUND TO STREAM
CLEAR WATER
HEALTHY HABITAT



MOST RAINFALL
RUNS OFF QUICKLY
LEADS TO:
-INCREASED FLOODS
AND DROUGHT
-INCREASED EROSION
ERODING
BANKS
REDUCED AMOUNT OF
WATER ABSORBED INTO GROUND
CLOUDY WATER
DEGRADED HABITAT



ALL RAINFALL
RUNS OFF
VERY QUICKLY
LEADS TO:
-FREQUENT FLOODS
AND DROUGHTS
-EROSION DOWNSTREAM
CONCRETE
BANKS
NO WATER ABSORBED
INTO GROUND.
PAVEMENT AND ROOFTOPS
ARE UNABLE TO ABSORB WATER
CLOUDY WATER
DEGRADED HABITAT

Do You Know What Happens When It Rains?

The last time it rained, did you notice what happened in your neighborhood?

Some of the soil from the Smiths' new construction washed away. Spilled paint and turpentine from the Costellos' painting project disappeared. The detergent Joe used to wash his car (and the oil that drips from it) bubbled into the street, along with a fair amount of the lawn treatment you just paid for. Liquids from the Murphys' overworked septic system surfaced again and joined everything else.

All this and more washed into the storm sewers under our streets and traveled directly (untreated by the sewage treatment plant) to the stream where the children hunt frogs or perhaps to the lake where you fish and swim or boat.

Most of us blame pollution and its effects on large industries, municipal treatment plants, and corporations. In reality, we're all responsible. It's time to take a closer look at pollution and where it comes from.

While a significant amount of water pollution can be directly linked to industrial and municipal wastewater treatment plants, in nearly all parts of the country much and sometimes most pollution comes from many other sources—nonpoint source or runoff pollution.

Watch the rain (or melting snow) as it runs off your roof, your street, and parking lots: you can see it pick up oil, grease, litter, soil, and other materials. Eventually this runoff carries them to the nearest body of water, where these pollutants can kill fish, shellfish, wildlife, or plants and degrade water quality.

But the invisible components of this runoff—such as nutrients, dissolved metals, bacteria, and pesticides—may be as damaging. For example, nitrogen and phosphorus found in soaps, septic effluent, and lawn and garden fertilizer are a serious threat to water quality.

Once these nutrients reach a body of water, they can cause sudden and excessive growth of algae and aquatic plants. When they die and decay, they deplete the oxygen needed by fish and other aquatic life.

Soil washed from streets, construction, and eroding land joins this decaying material to build sediment on the bottom of the lake or stream. Eventually, the decreasing depth will impede boating—and it will also necessitate costly dredging to maintain shipping channels, marinas, and other harbors.

Even as the runoff chokes these waterways, it also stops up storm drains and causes flooding. In the process, fish habitat is destroyed.

All of us - in our everyday activities - are polluters. It's our detergent, our fertilizer, our pesticides, oil, pet wastes, paints, and brake

Common Household Products that Contribute to Urban Runoff

- ammonia-based cleaners
- car waxes
- paints, paint thinners
- detergents with phosphates
- chrome and silver polish
- roach and ant killers
- degreasers
- furniture strippers and varnishes
- motor oil, gasoline, antifreeze, brake fluid
- concrete or wood sealants
- chlorine bleach
- paint and brush cleaners
- drain cleaners
- lawn-care chemicals
- toilet cleaners

fluids carried by stormwater runoff to a nearby lake, stream, bay, wetland, or pond.

The amounts may seem negligible, but multiplied by the number of acres, lots, and homes in a community they create significant pollution—enough to pollute the neighborhood stream to the point where it's not fit for humans or creatures.

But surface waters are not the only victim: pollutants can soak into the soil and contaminate groundwater, which then becomes a repository for pollutants carried by runoff.

More than half of us (90 percent of rural America) rely on groundwater. And the pollutants that seep into the soil through well casings, excessive watering and fertilizer application, dumping of oils and household chemicals, or failing septic systems can harm not only our own but also community well systems.

We must recognize that the way we live affects the quality of waters for drinking, bathing, and cooking as well as for fish and wildlife, swimming, boating, and fishing.

And water quality also affects the value of property adjacent to the waterbody; therefore, keeping it clean makes sense financially.

Ninety-five percent of us live within an hour's drive of a publicly owned lake, and 70 percent are similarly close to coasts. The water we have used (and the waste it carries) finds its way back to these waters, eventually limiting recreational opportunities for all, and usually destroying the area's economic base—marinas, resorts, restaurants, fishing and hunting suppliers.

We all know that it's difficult to clean up pollution—whether it's in the ocean or in our backyard. Cleanup is difficult and costly. Pollution prevention makes sense. By developing and practicing new water-conserving, nonpolluting habits in and around our own home, we will be actively protecting and cleaning up our waterways.

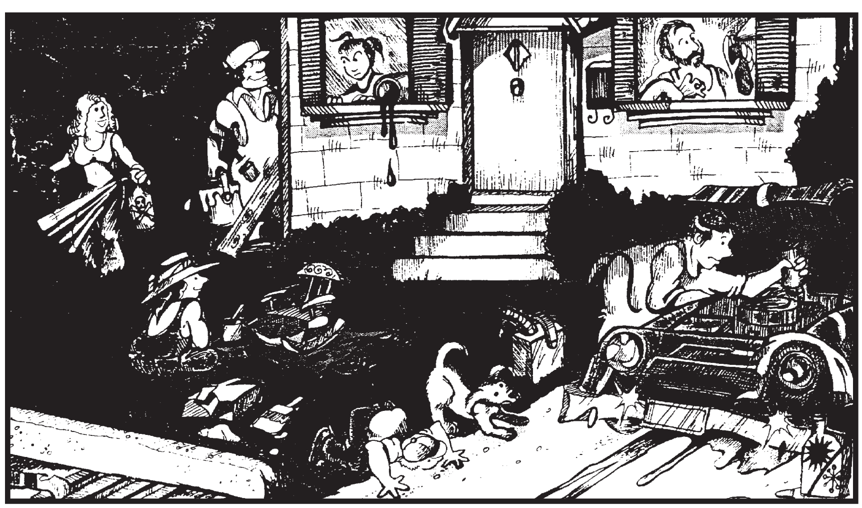
But to be truly effective, prevention must be a collective act, just as pollution is a collective result of our actions.

The responsibility for preventing pollution lies with all of us, and must be embedded in our everyday activities, our routine behavior. We must begin to instinctively think and act preventively, practicing three basic principles:

1. Reduce inputs: don't put on what you don't need.

2. Use environmentally friendly products.

3. Change the timing of your activities so as to minimize the amount of materials that will be washed off.



From: *Handle with Care, Your Guide to Preventing Water Pollution*, 1991. Terrene Institute, 1717 K Street Suite 801, Washington D.C 20006